

Agriculture-Forestry Options

The options discussed in this option have include the following goals related to reducing GHG emissions and increasing carbon sequestration in agricultural and forestry management:

1. Agriculture
 - a. Reducing carbon emissions by encouraging production of biomass fuels
 - b. Reducing methane emissions
 - i. Improved manure management
 - ii. Changing livestock feed
 - c. Increasing carbon sequestration
 - i. Encouraging innovative soil management
 - ii. Converting lands to grasslands or forests
 - iii. Preserving open spaces/agricultural lands
2. Forestry
 - a. Increasing carbon sequestration through
 - i. Protecting forests and planting trees
 1. Protecting forestlands by reducing conversion to non-forest uses
 2. Encouraging afforestation or restoration of nonforest lands
 3. Promoting urban and community trees
 4. Encouraging reforestation, proper stocking, and density management
 5. Developing best management practices for biomass removal
 - ii. Improving forest health in general
 1. Improving fire management and risk reduction
 2. Improving forest health
 - iii. Expanding use of wood products for building materials
 - b. Reducing carbon emissions by expanding use of forest biomass feedstocks for energy production

AF-1¹ - Promote Production of Biomass Fuels

This option includes promoting the production of ethanol, biomass, and other fuels.

Benefit/Cost of reducing CO₂e:

Arizona: 28 MMt between 2007-2020; \$0/ton

New Mexico: 7.5 MMt between 2007-2020; \$3/ton

Colorado: 0.1-1 MMt or more; \$5-50/ton; includes starch and cellulosic processes

Assessment: Priority: _____ Bin: C

We are not aware of any farm production for biofuels in Utah. There have been preliminary discussions only. DEQ held a pre-design meeting with a company that wanted to import corn for ethanol.

There is some research on Pinyon-Juniper woodlands.² Scott Truman (SUU) is working with the University of Ireland to test enzymes.

There is no cellulosic ethanol production yet. The federal government largely controls the supply of woody biomass, so there is the problem of a reliable supply. It is hard to say what the timetable might be for this developing into a viable option. Switchgrass and agricultural products might also be viable source of this. Utah does not grow a lot of corn and most goes for cattle feed. This could change if a market develops. The amount of corn grown is limited by land and water availability. We should keep this option alive. The key issue in ethanol production is location.

We should also include biodiesel feedstocks--plants that produce oil. Some small scale experiments are being done to explore what can be produced from this option. Cooking oil can also be used to produce biodiesel. It is not clear how good of a fit is this for Utah.

Biodiesel is still very preliminary in Utah. There are a few small-scale production examples.

¹ This option combines the old AF 1 and 2.

² Pinyon-Juniper woodlands are what you see, for example, in the Dixie National Forest. A lot of people want to clear it back to create more rangeland for cows because it appears to have encroached on grasslands as we've stopped allowing it to burn periodically. Some are hoping that we can convert it to biomass fuels/feedstock for vehicles or power generation. The idea is that it would be carbon neutral because it would absorb CO₂ from the air and sequester it until it is burned as fuel (thus creating a cycle).

AF-2 – Improve Manure Management³

This broad, umbrella option includes composting, manure, manure digesters, and optimal application of nitrogen fertilizers.

Benefit/Cost of reducing CO₂e:

Arizona: 3.8 MMt between 2007-2020; \$1/ton
 New Mexico: 6.3 MMt between 2007-2020; \$3/ton⁴
 Colorado: 0.1-1.0 MMt; unknown cost

According to the Utah DNR 2000 report, assuming that some practices will be adopted, one might assume that nitrogen emissions could be reduced by 5 percent. Based on the 2010 forecast of 127,290 tons of CO₂ equivalents, this translated into a savings of 6,365 tons.⁵

Assessment: Priority:_____ Bin: B

This option presents some good opportunities in Utah. Farmers generally do a good job with nutrient management but there are problems in urban areas with home/hobby gardening.

In Utah, there was a lot of initial interest in generating electricity onsite and then putting it onto the grid. Some research is being conducted at USU. Some net metering has been utilized. Digesters have been used in Northern Utah and also on a dairy in Sanpete County. The technology is still somewhat early for commercialization. Some efforts have been abandoned. Problems have been uncovered in getting enough natural gas produced from manure to generate electricity. Another problem encountered is that the manure tends to corrode engines. There are corroding agents that come off from gas from digesters. The technology needs another few years before we will know whether it is viable. However, the feeling is that it may be valuable because it reduces the flaring of methane, and methane is much more potent GHG than is CO₂. Digester technology is being improved and there are examples of manure management.⁶ Utah has identified and inventoried 99% of the State's feeding operations. Included in the inventory process is a plan for managing waste—land application as compost.

Estimates suggest that better practices could reduce nitrogen fertilizer use by as much as 20 percent. At this level, there is a low risk of yield penalty and the added possibility of input-cost savings to farmers.⁷ Improved management practices coupled with specific technologies may achieve energy savings by reducing the need for plowing and other energy intensive practices. Practices which could be improved include application rates, placements, and timing, soil testing frequency, low-nitrogen and/or fertilizer use, and conservation tillage. Technical approaches which could be followed include the use of fertilizer additives that increase nitrogen-use efficiency by decreasing nitrogen loss through volatilization, limiting or retarding fertilizer water solubility through super-granulation, and reducing nitrogen release. To a large degree, the modification of fertilizer practices is dependent on establishing effective ways of disseminate the knowledge of new practices

³ This option combines the old AF 3, 5, 7, and 8 options.

⁴ Projected for digester systems used on dairies, not feedlots.

⁵ Utah Department of Natural Resources, 2000.

⁶ See Circle Four/Smithfield Farms in Milford.

⁷ Utah's State Action Plan

AF-3 - Change Livestock Feed and Improve Productivity to Reduce Methane Emissions

Improved Ruminant Productivity programs increase the efficiency of dairy and beef cattle and other ruminant operations.⁸

Benefit/Cost of reducing CO₂e:

Arizona: 4.5MMt between 2007-2020; \$8/ton
New Mexico: 2.6MMt between 2007-2020; \$76/ton⁹
Colorado: 0.1-1.0 MMt; negative cost

The 2000 Utah DNR report indicated that according to industry estimates, methane emissions could be reduced by up to two percent per year if the above practices are employed. At this rate, 284,577 tons of CO₂ equivalents could be reduced by 2010 for a total of 1,271,105 tons emitted.¹⁰

Assessment: Priority: _____ Bin: B

If there are ways to shift feed rations that can impact methane emissions, then this is almost a “no brainer.”

USU is doing a lot of research on this issue. Competitive pressures to increase efficiency will encourage the dairy and beef industries to adopt some or all of the short-term process changes described. Improving productivity within the cow-calf sector of the beef industry requires additional education and training. The importance and value of better nutritional management and supplementation must be communicated. Energy, protein, and mineral supplementation programs tailored for specific regions and conditions need to be developed to improve the implementation of these techniques. The special needs of small producers must also be identified and addressed. There may be some manure management/methane opportunities further into the future.¹¹

⁸ Utah 2000

⁹ Biomass feedstocks for steam, electricity, or direct heat

¹⁰ Utah 2000

¹¹ Circle Four Farms in Milford is currently looking into this.

AF-4 – Encourage Innovative Soil Management¹²

This umbrella option includes encouraging a variety of management options for increasing carbon sequestration, such as:

- Conservation tillage/no-till agriculture to increase carbon sequestration of the soil and reduce energy use from reduced tractor use. It is not clear whether this approach to planting crops reduces CO₂ released from soils.
- Reduce summer fallow
- Increase winter cover crops
- Rotational grazing/Improve grazing crops
- Improve water & nutrient use – While there are significant co-benefits here, including a reduction in runoff and soil erosion, the main impact is on water use. There is only a peripheral carbon impact.
- Organic Farming - includes integrated pest management through biological rather than chemical means. It increases the carbon content of soils because manure, rather than commercial fertilizer, is used.

Benefit/Cost of reducing CO₂e:

New Mexico: 0.6MMt between 2007-2020; \$15/ton

Colorado: 0.1-1.0 MMT; \$5-50/ton

Organic farming:

New Mexico: 4.4 MMt between 2007-2020; \$0.5/ton

Colorado: 0.1-1.0 MMt; less than \$5/ton

Assessment: Priority: ____ Bin: B

This is not a large emissions reduction item, but something that should be considered. New Mexico's niche market for organic food production has been growing faster than Utah's (this may impact why New Mexico found larger potential for organic farming.)

Soil management is already being done in the industry. It provides a reduction in the amount of energy required to work with the soil. There may be a sequestration benefit.

There is a growing market for organic farming. More study is needed. Most of the organic farming benefits noted by New Mexico came from soil sequestration (carbon in soil). The information was unclear as to the benefits associated with reduced pesticides and fertilizer vs. soil management. Colorado noted that sequestration is believed to be greater in organic farmland than conventionally farmed land.

¹² Includes old AF 11, 12, 13, 14, and 19 options.

AF-5 - Convert Land to Grassland or Forests

Benefit/Cost of reducing CO₂e:

New Mexico: 4 MMt between 2007-2020; \$7/ton¹³

Colorado: 0.1-1.0 MMt; unknown

Assessment: Priority: ____ Bin B.

There is some uncertainty as to the overall emissions benefit of this option, but there may be some opportunities.

The United States Department of Agriculture, under the Conservation Reserve Program (CRP), pays farmers to retire agricultural lands that are highly susceptible to erosion. This has been very successful for marginal lands. Farmers are usually paid a certain amount per acre per year for 10 years. The Natural Resources Conservation Service has data on the amount of lands under CRP in Utah.

Foresters are interested in this as a model for stream buffer requirements. It's important to address what's being converted and from what. The benefit is that the coverage could be permanent.

Oregon specifies that marginally productive agricultural and brush lands are to be converted. The second projection is for Oregon's policy option that calls for the "leverage" of the Conservation Reserve Program which provides farmers with incentives to convert agricultural land and rangeland to forest.

Other states require forests to set aside a buffer strip to protect riparian areas. Utah does not since farmers are paid to do this. Forest owners could also be paid to create these buffer lands.

There could be carbon credits associated with this measure. There was some concern that that this is too short term (~10 years) for credits.

¹³ Emissions reductions are taken against emissions that have not been built into the existing forecast for NM. They refer to emissions associated with acreage assumed to be coming out of the Conservation reserve program and returned to active cultivation. Since they aren't included in the baseline, these reductions are left out of the totals.

AF-6 - Preserve Open Space/Agricultural Land

Benefit/Cost of reducing CO₂e:

Arizona: 1.6 MMt between 2007-2020; \$65/ton

New Mexico: 1.6 MMt between 2007-2020; \$62/ton

Colorado: 0.1-1.0 MMt; unknown cost ¹⁴

Assessment: Priority: _____ Bin: B

This is an important value, but carbon emission reductions have a high cost per ton.

Sequestration and uptake is greater in agricultural land than other land uses.

Lands could be protected through conservation easements. The Federal Forest Legacy Program provides about \$2-3 million a year to Utah. A similar effort could apply to ranches. The state should expand the LeRay McCallister program to protect open lands.

This option appears to be expensive but has important co-benefits for ranching and forestry. Example includes the Forest Legacy program through USDA Forest Service.

This option could include promoting "no net loss" of agricultural land. ¹⁵

¹⁴ Reductions here occur from higher carbon retention in soil and decreased transportation activity.

¹⁵ This option includes the old AF-17 option.

**AF-7 - Protect Forestland by Reduced Conversion to Non-forest Uses
(urban, suburban, and rural lands)**

Benefit/Cost of reducing CO₂e:

Arizona: 3.7 MMt between 2007-2020; \$17/ton

New Mexico: 1.2 MMt between 2007-2020; \$22/ton

Colorado: 0.1-1.0 MMt or higher; \$5-50 or higher¹⁶

Assessment: Priority: _____ Bin: B

The benefits here are similar to those for AF-6.

Healthy forests promote carbon sequestration and reduce carbon releases. This option has significant co-benefits such as wildlife habitat, recreational opportunities, water and air filtration, and reduced risk of fires. As the climate changes, it is anticipated that fires will become more severe, and will occur earlier in the year.

Utah should promote existing wildland-urban interface and conservation easement programs. Federal funding is available these types of projects. This year, the State lost over \$1 million in funding from federal government this year; there is concern about future funding. The Federal Forest Legacy program usually funds Eastern states; the case should be made for more funding to western states. The LeRay McCallister program could be expanded. Other sources include WUI protection program, and Quality Growth Fund (promoting existing WUI and Federal and State open lands protection/conservation easement programs).

¹⁶ Reductions depend on current rates of clearing; large amounts of carbon can be protected per acre.

**AF-8 – Encourage Afforestation and or Restoration of Nonforest land
(including urban, suburban and rural lands)**

Benefit/Cost of reducing CO₂e:

Arizona: 0.7 MMt between 2007-2020; \$44/ton
New Mexico: Residential: 2.5 MMt between 2007-2020; \$46/ton
Other: 6.3 MMt between 2007-2020; \$15/ton
Colorado: 0.1-1.0 MMt; \$5-50/ton or higher¹⁷

Assessment: Priority: _____ Bin: B

This should apply to rural forests only. Compare with AF-9.

The assumption is that health, productive trees can reduce carbon. Scientists are debating whether there is a net benefit from planting trees.¹⁸ Forests can sequester as well as release carbon. They also contribute to warming/cooling cycles through absorption/reflection.

¹⁷ Reductions depend on available land; high rate of sequestration per acre.

¹⁸ See Lawrence Livermore study discussed in Society of American Forestry, Forestry Source, February 2007

AF-9 - Promote Urban and Community Trees¹⁹

Benefit/Cost of reducing CO₂e:

Colorado: less than 0.1 MMt; less than \$5-50/ton²⁰

Oregon: not cost effective over action's lifetime

Assessment: Priority: _____ Bin: A

There are tremendous opportunities for carbon uptake here. Other benefits are cooling and reducing the need for air conditioning.

These types of programs are very popular with the public. Through the Tree City USA program, cities that enact ordinances requiring spending on trees can receive federal funding. Other existing programs include Utah Community and Urban Forest Council, and urban and community forestry. The state allocated \$200,000 for urban forestry this year. A 37% reduction in next year's federal budget is anticipated so state money was very timely.

There is an ongoing need for people to have information about residential tree planting. An educational program would be useful.

¹⁹ Previously called Increased Maintenance of Urban Street and Residential trees.

²⁰ Cost savings are possible if thinnings are directed towards product and energy use.

**AF-10 – Promote Reforestation, Proper Stocking, and
Density Management of Managed Stands²¹**

Benefit/Cost of reducing CO₂e:

Colorado: 0.1-1.0 MMt; \$5-50/ton or higher²²
0.1-1.0 MMt or higher; less than \$5 – 50/ton²³

Assessment: Priority: _____ Bin: C

Most of Utah's forests are federally owned and are covered by US Forestry Services' reforestation requirements.

A voluntary forest stewardship program covers private lands. Cost-sharing encourages owners to use best management practices. The state forest stewardship program offers planning services. Landowners can get funding to match their expenses, which may include sweat equity. State foresters are available to help landowners, but they encourage landowners to do a forest stewardship plan and take a long-term focus. A recent audit showed that 89% of Utah's private landowners are voluntarily participating in the BMP program. Increased incentives, rather than a regulatory hammer, may be the most effective method to expand this program's effectiveness.

A USU program trains timber companies on land management practices. USU brochures offer tips to land owners on recognizing responsible logging companies. It also provides sample leasing contracts.

Age extension of forest stands – extending rotation to extend sequestration - makes more sense in wetter forests where trees last longer. In the Rockies, trees are not as long living as they do on the West coast because of fires. Research by Mark Harmon suggests that older forests have such respiratory requirements that they are actually giving off CO₂. In addition, it takes about 70 years to get rid of old forest decomposition.²⁴ Young forests sequester more carbon. Thinning can be an important means of producing forest health.

Moving to a natural cycle would mean more fires. See AF12.

Research on urban forests has revised hardiness zone categories because of climate change.

Oregon did look into reforesting quickly after disturbance and reducing forest density to keep trees healthy.²⁵

This option has a carbon co-benefit: a reduction in fire risk and loss of carbon sequestration, healthier forests, and protection of habitat, recreational opportunities, and rural housing.

²¹ This option includes the old AF-25, 26, 27, and 33 options.

²² Reforestation/Restoration of managed stands

²³ Thinning and Density Management of Managed Stands

²⁴ The group raised the possibility of using this material for cellulosic ethanol. See also AF1

²⁵ See Forests, Carbon and Climate Change, Oregon Forest Resources Institute, Oregon State Univ. (summary of larger report));

AF-11 – Develop and Implement Best Management Practices for Biomass Removal

This includes improved logging residue recovery to reduce decay at forest floor and develop feedstocks for energy production (renewable, carbon-neutral energy)²⁶

Benefit/Cost of reducing CO₂e:

Arizona:	Residential:	6.4 MMt between 2007-2020; \$21/ton
	Other:	2.9 MMt between 2007-2020; \$21/ton
New Mexico:	Residential:	2.5 MMt between 2007-2020; \$46/ton
	Other ²⁷ :	6.3 MMt between 2007-2020; \$15/ton
Colorado:		less than 0.1-1.0 MMt ²⁸ ; uncertain cost

Assessment: Priority: _____ Bin: A

A major challenge with biomass is how to fund the cost of doing it and whether markets can be developed to pay for this. Options for reducing biomass include burning it, bringing in goats, or using mechanical means. The latter two are expensive. The decision to use fire must factor in how close the forests are to houses.

Biomass-specific best management practices (BMP) are needed.²⁹ There is nationwide interest in this type of BMP. Reducing decay to forest floor is largely a moisture issue. We may need a special set of rules for harvesting smaller diameter trees.

Woody biomass is carbon neutral. To meet renewable energy targets, companies could mix woody biomass with coal to satisfy Oregon and California standards. The Utah state law providing for tax credits on renewable energy exempts wood pellet stoves unless woody biomass was used to produce the fuel.

²⁶ Includes old options AF-39 and 42.

²⁷ Manage sustainable thinning to direct biomass towards wood products and renewable energy.

²⁸ Reductions depend on available acreage, current practice, and energy production.

²⁹ Current biomass BMP target reducing stream sediment. While this is a worthy goal, it does not get at the entire biomass issue.

AF-12 – Increase Fire Management and Risk Reduction Programs**Benefit/Cost of reducing CO₂e:**

Colorado: less than 0.1-1.0 MMt³⁰ between 2007-2020; uncertain cost
 Oregon 3.2 MMt between 2007-2025; cost effective³¹

Assessment: Priority: _____ Bin: A

It is critical to avoid catastrophic carbon releases from forest fires.

Healthy forests take up carbon and sequester it, and healthy forests are less likely to burn. An entire forest could be lost in a fire. Reducing fires produces an important public safety benefit; other co-benefits are forest health, recreation, and wildlife.

Burning woody biomass is considered to be carbon neutral. If it is left in the forest, it would burn or decompose. If it is burned in a controlled fashion, there is less particulate.

Better funding and more research on the role of forest fires in climate change is needed.³² Utah receives \$1 million annual under the Federal fire plan. With a reduced budget, the focus is on the wildland-urban interface. Rural fires allowed to burn after years of fuel build-up burn unnaturally hot, baking the soil and killing trees that otherwise might not burn in a less hot fire. There is a need to reset the burning temperature by restoring a more natural fire regime.

There is a conflict with environmental advocates who oppose development of roads to fight fires because affected lands can then no longer qualify for wilderness.

It is expensive to do mechanical thinning.³³ Some of the cost can be offset if the wood can be sold, but there typically aren't markets for forest biomass. Another "thinning" option is stewardship contracting – allowing timber companies to cut big trees to pay for the cost of removing the smaller ones, a move opposed by some environmental groups. Utah has signed a MOU that promotes the use of stewardship contracts. Agencies can retain receipts from harvesting and use them locally, unlike for timber cuts. There is also no need to award bids to the lowest contractor and the state can consider other factors of concern to the local community.

³⁰ Reductions may be low because primary objective is not carbon sequestration.

³¹ Creating a market for biomass from forests is key to this option. It would be important to locate biomass fueled generating plants close to forests to reduce the economic and GHG costs of shipping.

³² See Steve Running's research on global warming and increasing forest fires.

³³ \$900-1300/acre to thin

AF-13 – Increase Forest Health (pest/disease, invasive species) Risk Reduction Programs³⁴

An umbrella option that includes:

- Drought management programs--tree selection, placement, protection against drought
- Flood and riparian management programs
- Watershed management programs – stand retention, enhancement and management

Benefit/Cost of reducing CO₂e:

Colorado: less than 0.1-1.0 MMt; uncertain

Assessment: Priority: ____ Bin: A

Healthy forests are of critical importance for carbon and other issues.

Healthy forests take up carbon and sequester it and are less likely to lose it catastrophically. Healthy grasslands and aspen may sequester more carbon than other mixes of trees and plants.

Aspens are declining throughout the West and no one apparently knows exactly why. Douglas fir forests are encroaching on aspen and they use more water. Cheatgrass increases risk of fire.

A recent Colorado forest health report raises concerns. That state lost 1,000 square miles of forests due to multiple stresses of drought and beetles. Drought is the primary stress. When trees are weakened, beetles have more impact. It may be that warmer temperatures also increase the generations of beetles and fewer die during winter months.

Carbon issues could be integrated with rangeland health, healthy watersheds, fisheries, and aspen concerns. The State should continue to support the Utah Watershed Initiative and the Utah Partnership for Conservation and Development.

³⁴ This option combines the old AF 34, 35, 36, and 37 options

AF-14 – Expand Use of Wood Products for Building Materials

Benefit/Cost of reducing CO₂e:

Colorado: 0.1-1.0 MMt; uncertain³⁵

Assessment: Priority: ____ Bin: D

The benefit of using wood in construction is that it sequesters carbon for a long time and minimizes the use of other materials, like steel, that require more carbon in production. It should also be noted, however, that expanding the use of forestry products means harvesting larger trees that sequester more carbon. It is important to distinguish between thinning and traditional forestry products use.

There are better uses for wood than just allowing it to create a fire hazard. However, Utah is not a big timber state. Much of our woody material is non-merchantable and therefore cannot be readily adopted to building materials. It is difficult to assess the prospects for this in Utah.

³⁵ Cost depends on the relative costs of materials.

**AF-15 Expand Use of Forest Biomass Feedstocks for Energy Production
(fuel switching)**

Benefit/Cost of reducing CO₂e:

Arizona: 4.5 MMt between 2007-2020; \$8/ton
New Mexico: 2.6 MMt between 2007-2020; \$76/ton
Colorado: 0.1-1.0 MMt or higher; less than \$5-50/ton
Oregon: 3.2 MMt between 2007-25; cost effective

Assessment: Priority: _____ Bin: D

Wood biomass is carbon neutral and renewable.

Incentives, such as tax credits, should be enhanced to encourage this option.

Oregon's assessment noted that creating a market for biomass from forests is key to this option. It is important to locate biomass fueled generating plants close to forests to reduce the economic and GHG costs of shipping.

Oregon is prohibited from purchasing CO₂ intense electricity. This has caused problems for IPP which is considering co-firing with wood waste.

In Utah, the scale is likely to be small. It can be costly and/or politically difficult to get product from forests to power generation facilities/energy consumption options. There are still many unknowns with this option.